CLAIMS:

1. A process for making rare earth (RE) doped optical fiber, said process comprising steps of :

a) providing deposition of P_2O_5 and F doped synthetic cladding within a silica glass substrate tube to obtain matched or depressed clad type structure,

b) forming a core by depositing unsintered particulate layer at a tube surface temperature in the range of 1200-1400°C,

c) maintaining P_2O_5 and GeO_2 concentrations from 0.5 to 5.0 mol% and 3.0 to 25.0 mol% in the said particulate layer respectively to obtain a tube containing F-doped cladding and porous soot layer,

d) immersing the tube containing the porous soot layer into a solution containing RE salt in the concentration range of 0.002 M to 0.25 M with or without aluminum salt in the concentration range 0.05 M to 1.25 M for a period of 1 to2 hours,

e) draining the solution out at a rate in the range of 10-50 cc/min,

f) drying the porous layer by flowing dry nitrogen or any other inert gas through the tube,

g) heating the tube gradually in presence of oxygen at a temperature ranging between 600 - 1100°C ,

h) dehydrating the core layer of the tube at a temperature in the range of about 800-1200°C and in presence of excess Cl_2,

i) sintering the core layer in presence of a mixture of oxygen and helium in the temperature range between 1400 to 1900°C,

j) collapsing the tube by usual method at a temperature ranging from 2000-2300°C to obtain a preform,

k) overcladding the preform with silica tube, and

l) drawing fibers from the preform by the conventional methods.

2. A process as claimed in claim 1 wherein, the theoretically estimated relative density of the porous soot ranges between 0.30 to 0.50 to avoid core-clad

interface defect.

3. A process as claimed in claim 1 wherein, the RE salt used is selected from chloride, nitrate or any other salt soluble in solvent used in the process.
4. A process as claimed in claim 1 wherein, the aluminum salt used is selected from chloride, nitrate or any other salt soluble in solvent used in the process.
5. A process as claimed in claim 1 wherein, the solution for aluminum and erbium salt is prepared using solvent selected from alcohol and water.
6. A process as claimed in claim 1 wherein, the mixture of O_2 and He is in the range of 3:1 to 9:1.
7. A process as claimed in claim 1 wherein, the source of chlorine is CCl_4 where He is used as carrier gas.
8. A process as claimed in claim 1 wherein, the proportion of Cl_2: O_2 is ranging from 1.5: 1 to 3.5: 1 while the dehydration period lies between 1 to 2 hours.
9. A process as claimed in claim 1 wherein, during sintering of porous core layer $GeCl_4$ is supplied with the input oxygen maintaining a temperature of 1200°C to 1400°C.
10. A process as claimed in claim 1 wherein, sintering in germania rich atmosphere facilitates higher germania incorporation and reduces the quantity of germanium halide necessary during deposition.
11. A process as claimed in claim 1 wherein, the oxidation step before drying and sintering of the particulate layer reduces the possibility of change in composition due to evaporation of RE salts during subsequent processing.
12. A process as claimed in claim 1 wherein, the increase in temperature in steps of 50 to 200°C during oxidation and sintering stages prevents diffusion of RE and the codopants from the doped region resulting to minimum change in composition.
13. A process as claimed in claim 1 where the incorporation efficiency of RE in the doped region is increased.
14. A RE doped optic fiber produced by the process as claimed in claim 1.
15. An improved process for producing Er doped fiber in particular characterized by Er ion distribution in the core similar to the Gaussian pump beam intensity distribution wherein, the said process comprising steps of :

(a) providing deposition of P_2O_5 and F doped synthetic cladding within a silica glass substrate tube to obtain matched or depressed clad type structure,

(b) forming a core by depositing unsintered particulate layer at a tube surface temperature in the range of 1200-1350°C,

(c) maintaining P_2O_5 and GeO_2 concentrations from 0.5 to 3.5 mol% and 3.0 to 20.0 mol% in the said particulate layer respectively to obtain a tube containing F-doped cladding and porous soot layer,

(d) immersing the tube containing the porous soot layer into a solution containing Er salt in the concentration range of 0.004 M to 0.20 M with or without aluminum salt in the concentration range 0.05 M to 1.0 M for a period of 1 to2 hours,

(e) draining the solution out at a rate in the range of 10-30 cc/min,

(f) drying the porous layer by flowing dry nitrogen or any other inert gas through the tube,

(g) heating the tube gradually in presence of oxygen in the temperature range 700 - 1000°C ,

(h) dehydrating the core layer of the tube at a temperature in the range of 800-1200°C and in presence of excess Cl_2,

(i) sintering the core layer in presence of a mixture of oxygen and helium in the temperature range of 1400 to 1800°C,

(j) collapsing the tube by usual method at a temperature in the range of 2000-2300°C to obtain a preform,

(k) overcladding the preform with silica tube, and

(l) drawing fibers from the preform by the conventional methods.

16. A process as claimed in claim 15 wherein, the theoretically estimated relative density of the porous soot ranges between 0.30 to 0.50 to avoid core-clad interface defect .

17. A process as claimed in claim 15 wherein, the erbium salt used is selected from chloride, nitrate or any other salt soluble in solvent used in the process.

18. A process as claimed in claim 15 wherein, the aluminum salt used is selected from chloride, nitrate or any other salt soluble in solvent used in the process.

19. A process as claimed in claim 15 wherein, the solutions for aluminum and erbium

salts are prepared using solvent selected from alcohol and water.

20. A process as claimed in claim 15 wherein, the mixture of O_2 and He is in the range of 4:1 to 9:1.
21. A process as claimed in claim 15 wherein, the source of chlorine is CCl_4 where He is used as carrier gas.
22. A process as claimed in claim 15 the proportion of Cl_2: O_2 is varying from 1.5:1 to 3.5: 1 while the dehydration period lies between 1 to 2 hours.
23. A process as claimed in claim 15 wherein, during sintering of porous core layer $GeCl_4$ is supplied with the input oxygen maintaining a temperature of 1200°C to 1400°C.
24. A process as claimed in 15 wherein, the developed fibers have a controlled distribution of RE ion in the doped region with maximum concentration at the centre similar to the Gaussian pump beam intensity distribution in the fiber so that the overlapping between the two is considerably improved, consequently increasing the pump conversion efficiency in the fiber.
25. A process as claimed in 15 wherein, the pump beam has a radius of distribution equal to or greater than the radius of distribution of Er ions in the core, which enhances the chance of all the active ions getting exposed to the pump light.
26. A process as claimed in 25 wherein, relatively high gain is achieved in the fibers for NA value close to 0.20.
27. A process as claimed in 15 wherein, wide variation in composition between the core and cladding glass is avoided due to relatively low NA of the fiber eliminating problems like residual stress and PMD, which may substantially degrade the performance of the fiber.
28. A process as claimed in 15 wherein, the compositions of the core and cladding glass are suitable to achieve NA of 0.20 and Er^{3+} ion concentration in the range of 100 to 1500 ppm without clustering in order to provide EDF suitable for pumping at 980 nm for amplification of the input signal with gain in the range 10 to 37 dB for optical amplifier application.
29. A process as claimed in 15 wherein, the developed fibers have NA and mode field diameter not widely different from signal transmitting fiber for ease of splice and this minimizes the optical loss of the signal travelling through the

fibers.

30. A process as claimed in 15 wherein, sintering in germania rich atmosphere reduces the quantity of germanium halide necessary during deposition to achieve the desired NA.

31. A process as claimed in 15 wherein, the oxidation step before drying and sintering of the particulate layer reduces the possibility of change in composition due to evaporation of Er salts during subsequent processing.

32. A process as claimed in 15 wherein, the increase in temperature in steps of 50 to 200°C during oxidation and sintering stages prevents diffusion of RE and the codopants minimizing the possibility of change in composition.

33. A process as claimed in 15 wherein, the incorporation efficiency of RE in the doped region is increased which in turn increases the economy and repeatability of the process.

34. A process as claimed in 15 wherein, the numerical aperture of the fiber is varied from 0.10 to 0.30 maintaining Er concentration in the core between 50 to 6000 ppm along with variation in Er distribution profile in the doped region to produce fibers suitable for application as amplifiers, fiber lasers and sensors for different purposes.

35. An Er doped optic fiber produced by the process as claimed in claim 15.

36. A method of controlling the Gaussian RE distribution profile along the radial direction in a core used in a process for making rare earth doped optical fiber wherein, the said method comprises the steps of :

a) forming a core by depositing unsintered particulate layer at a tube surface temperature in the range of 1200-1400°C,

b) maintaining P_2O_5 and GeO_2 concentrations from 0.5 to 5.0 mol% and 3.0 to 25.0 mol% in the said particulate layer respectively to obtain a tube containing F-doped cladding and porous soot layer,

c) immersing the tube containing the porous soot layer into a solution containing RE salt in the concentration range of 0.002 M to 0.25 M with or without aluminum salt in the concentration range 0.05 M to 1.25 M for a period of 1 to 2 hours,

d) draining the solution out at a rate in the range of 10-50 cc/min,

e) drying the porous layer by flowing dry nitrogen or any other inert gas through the tube,

f) heating the tube gradually in presence of oxygen in the temperature range 700 - 1100°C and increasing the temperature in steps of 50 to 200°C,

g) dehydrating the core layer of the tube at a temperature in the range of 800-1200°C and in presence of excess Cl_2,

h) sintering the core layer in presence of a mixture of oxygen and in the temperature range of 1400 to 1900°C increasing the temperature in steps of 50 to 200°C,

i) collapsing the tube by usual method at a temperature in the range of 2000-2300°C to obtain a preform, and

j) drawing fibers from the preform by the conventional methods.

37. A process as claimed in claim 36 wherein, the theoretically estimated relative density of the porous soot ranges between 0.30 to 0.50 to avoid core-clad interface defect.

38. A process as claimed in claim 36 wherein, the RE salt used is chloride, nitrate or any other salt soluble in solvent used in the process.

39. A process as claimed in claim 36 wherein, the aluminum salt used is selected from chloride, nitrate or any other salt soluble in solvent used in the process.

40. A process as claimed in claim 36 wherein, the solutions for aluminum and erbium salts are prepared using solvent selected from alcohol and water.

41. A process as claimed in claim 36 wherein, the mixture of O_2 and He is in the range of 3:1 to 9:1.

42. A process as claimed in claim 36 wherein, the source of chlorine is CCl_4 where He is used as carrier gas.

43. A process as claimed in claim 36 the proportion of Cl_2: O_2 is varying from 1.5: 1 to 3.5: 1 while the dehydration period lies between 1 to 2 hours.

44. A process as claimed in claim 36 wherein, during sintering of porous core layer $GeCl_4$ is supplied with the input oxygen maintaining at a temperature ranging from 1200°C to 1400°C.

45. A process as claimed in claim 36 wherein, the oxidation step before drying and sintering of the particulate layer reduces the possibility of change in composition

due to evaporation of Er salts during subsequent processing.

46. A process as claimed in claim 36 wherein, the stepwise increase in temperature during oxidation and sintering stages prevents diffusion of RE and the codopants which in turn prevents change in composition.

47. A process as claimed in claim 36 wherein, the numerical aperture of the fiber is varied from 0.10 to 0.30 maintaining RE concentration in the core between 50 to 6000 ppm along with variation in the RE distribution profile in the doped region to produce fibers suitable for any devices.

48. A process as claimed in claim 36, wherein the devices are amplifiers, fiber lasers, and sensors for different purposes and other devices where optical fiber is used.

49. An optic fiber produced by the method of claim 36 wherein, the distribution profile of the rare earth ions are controlled by Gaussian RE distribution profile along the radial direction.